AN ESSENTIAL CORRELATION OF H- AND L-CHONDRITE DISTRIBUTIONS OVER COSMIC-RAY EXPOSURE AGES AND EXTENSIONS OF THE ORBITS.
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The revealed feature that the H and L chondrites with especially extensive orbits (aphelion q´ >~ 4 AU) are mostly related to the regions of manifested maxima in the chondrite cosmic ray exposure age distributions implies that it is precisely those catastrophic events, which have generated the majority of the chondrites, could transfer a part of them to very eccentric orbits.

Due to modern methods of investigation, meteoritics as a science is progressing impetuously. First of all, it concerns experimental work because the modern laboratories had been fully equipped with the most elaborate instruments to study lunar samples. Nowadays, the accumulation of empirical information on many aspects of meteoritics had already reached so high level that the statistical methods of investigation became applicable and very efficient. The most important characteristics of meteorites classifying their origin and evolution over temporal and spatial scales are radiogenic and cosmic-ray exposure ages and orbits. In [1–3] a constructive statistical approach has been elaborated, which makes it possible to consider properties and features of events in their life on a long timescale. A similar line of attack to study the features and properties of meteorites depending on the extension of their orbits and to associate so their appearance with some processes in the interplanetary space turned out to be possible due to the elaborated original approach to estimates of aphelion q´ of orbits for all the meteorites in which the ^{26}Al content has been measured [4–6].

The best illustration of the statistical method operation is presented in Fig. 1, which demonstrates peculiarities of H- and L-chondrite formation along the cosmic-ray exposure age axis. It is seen that the number of chondrites of both groups decreases generally exponentially when the age increases (left plots). Besides, there is a very noticeable peak at ~7 m.y. in the H chondrite age distribution and a less manifested peak at ~20 m.y. in the L chondrite age distribution (both are more marked on the logarithmic scale, right plots). Obviously, H and L chondrites are produced continuously in ordinary collisions, but, moreover, almost half of the H chondrites and a relatively large fraction of the L chondrites have been generated in catastrophic events that resulted, perhaps, in complete disintegration of their parent bodies ~7 m.y. and ~20 m.y. ago, respectively. The question arises where those events could take place.

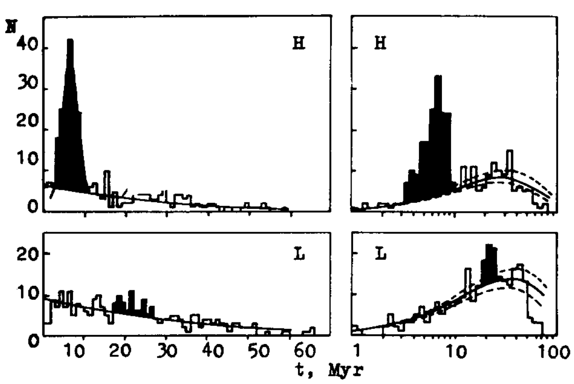

Fig. 1. Distributions of cosmic-ray exposure ages of H and L chondrites along linear (left plots) and logarithmic (right plots) scales [2]. (N is the number of chondrites.)

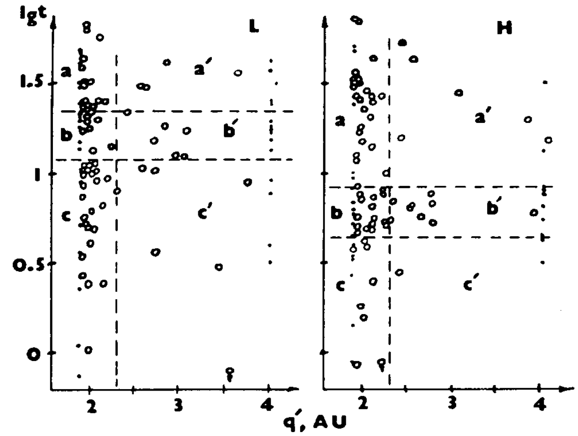

Fig. 2. Interrelations between cosmic-ray exposure age t and aphelion q´ for 100 L and 102 H chondrites (open circles are data for the chondrites with 1.9 < q´ < 4 AU; points are for data for those with q´ ≤ 1.9 AU and q´ ≥ 4 AU; dashed verticals separate regions with q´ < 2.3 AU and q´ > 2.3 AU; dashed horizontals set off the regions bb´ of maximum number of L and H chondrites on the age scale between t = 11–22 m.y. and t = 4.5 –8.5 m.y. respectively).

Valuable information on this point is derived from the interrelations between the age and aphelion distributions of the chondrites in Fig. 2 (the data on q´ have been obtained in [7]). It is seen that the largest dispersion of the ages is for the chondrites with q´ < 2.3 AU, which could be conditioned in part by some random factors in that the most-populated part of interplanetary space is near the inner boundary of the asteroid belt. Primarily, it may be collisions of cosmic bodies leading to losses of the noble gases used in isotopic chronology. Besides, such processes as solar wind implantation, irradiation by solar and galactic cosmic rays, heating by the Sun, etc. are also most effective in that region, as compared to the more distant ones [3,6]. On the other hand, the H and L chondrites with q´ > 2.3 AU (and especially with q´ > ~4 AU) are grouped in the age regions near the peaks discussed above. Indeed, if a, a´, b, b´, c, and c´ are the numbers of the chondrites in the regions indicated in Fig. 2, the ratios of (b´/b)/[a´ + c´)/(a + c)] are equal to 2.8 and 1.9 for H and L chondrites respectively. It is natural to suppose that it is precisely those catastrophic events with complete disintegration of the parent bodies, which generated the relative majority of the H and L chondrites ~7 m.y. and ~20 m.y. ago respectively, could transfer a part of them to very stretched, eccentric orbits. In accordance with [7], the parent bodies are expected to have the following most probable values of q´ ~ 1.9–2.0 AU, e ~ 0.30–0.35, and q ~ 1 AU.

References: [1] Alexeev V. A. (1991) *Astron. Vestnik, 25*, 372. [2] Alexeev V. A. (1992) *LPS XXIII*, 17; (1993) *Astron. Vestnik, 27,* 81 [3] Alexeev V. A. and Ustinova G. K. (1995) *Nucl. Geophys., 9*, 609. [4] Ustinova G. K and Lavrukhina A. K. (1980) *LPS XI*, 1187. [5] Lavrukhina A. K. and Ustinova G. K. (1972) *EPSL, 15*, 347. [6] Lavrukhina A. K. and Ustinova G. K. (1990) *Meteorites as Probes of Cosmic Ray Variations*, Nauka, Moscow, 262 pp. [7] Ustinova G. K. and Alexeev, V. A, this volume.